ElectriCOIL: Electric Discharge Pumped Oxygen - Iodine Laser

Glen Perram, Professor of Physics

Abstract:

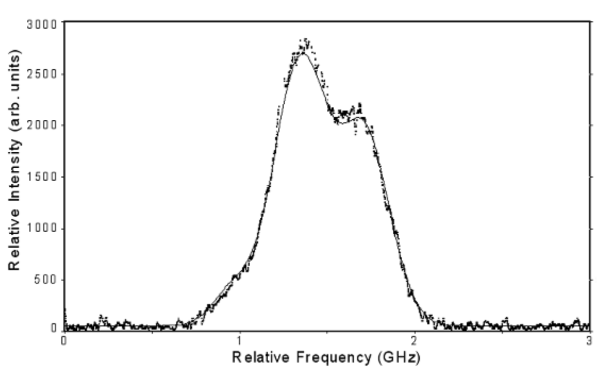
Chemical lasers offer the highest powers necessary for many weapons applications, but require significant logistical support in the delivery of specialized fuels to the battlefield. In the Chemical Oxygen-Iodine Laser (COIL), which is the weapon aboard the Airborne Laser (ABL), gaseous chlorine and liquid basic hydrogen peroxide is used to generate the singlet oxygen energy reservoir. The goal of the current research program is to demonstrate an oxygen-iodine laser with electric discharge production of singlet oxygen. As part of a multi-university research initiative, our program focuses on measuring key kinetics rates that control the efficiency and scalability of the potential laser system.

Research Methods:

Three distinct experiments are in progress: (1) development of an optical diagnostic to measure the spatially resolved temperature in the supersonic mixing nozzle of a COIL device based on a variant of laser saturation spectroscopy, (2) measuring the rates and branching ratios for the transfer of energy between the first two electronically excited states of molecular oxygen, using CW laser induced fluorescence techniques, and (3) determine the rate of dissociating singlet oxygen by electron impact by two photon laser induced fluorescence detection of oxygen atoms.

Results:

A typical laser saturation spectrum for an isolated rotational line in the visible for molecular iodine in a supersonic nozzle expansion is shown in the figure. A curve fit to the 15 hyperfine components yields a spatially resolved temperature of T = 146.2 ± 1.2 K.



Publications:

G.T. Phillips, G.P. Perram and W.B. Roh,*"Spatially-Resolved Temperature Diagnostic for the Chemical Oxygen-Iodine Laser Based on a Variant of Saturation Spectroscopy"*, Gas and Chemical Lasers and Intense Beam Applications III, SPIE **4631**, p145-153 (2002).

Grady T. Phillips and Glen P. Perram, *"Spatially-Resolved Temperatures in Laser Mixing Nozzles Using Laser Saturation Spectroscopy",* 34th AIAA Plasmadynamics and Lasers Conference, Orlando, FL, 23-26 June 2003.

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As an experimentalist in the area of chemical physics, Dr Perram's research interests include chemical lasers, remote sensing, optical diagnostics, laser physics, atomic and molecular spectroscopy, reaction kinetics, environmental science, and photochemistry. He has received 20 research grants and published over 60 articles in applied physics and optics. During his 14 years on the AFIT faculty he has advised 16 PhD and 28 MS students and teaches graduate courses in quantum mechanics, spectroscopy, lasers, chemical kinetics, space surveillance, atmospheric chemistry and optics. Dr Perram is a registered professional engineer in the State of Ohio.

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